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IS 11423 (1985): Portable Prospecting Radiation Meters with Geiger-muller Counter Tube (Linear Scale Instruments) [LITD 8: Electronic Measuring Instruments, Systems and Accessories]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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*Indian Standard*

SPECIFICATION FOR PORTABLE PROSPECTING RADIATION METERS WITH GEIGER-MULLER COUNTER TUBE (LINEAR SCALE INSTRUMENTS)

National Foreword

This Indian Standard which is identical with IEC Pub 421 (1973) 'Portable prospecting radiation meters with Geiger-Muller counter tube (linear scale instruments)', issued by the International Electrotechnical Commission (IEC) was adopted by the Indian Standards Institution on the recommendation of the Nuclear Instrumentation Sectional Committee and approval of the Electronics and Telecommunication Division Council.

Wherever the words 'International Standard' appear, referring to this standard, they should be read as 'Indian Standard'.

Cross References

In this Indian Standard, the following International Standards are referred to. Read in their respective place the following :

<i>International Standard</i>	<i>Corresponding Indian Standard</i>
IEC Pub 50 (20) (1958) International electrotechnical vocabulary: Scientific and industrial measuring instruments [Superseded by IEC Pub 50 (301, 302 and 303) (1983)]	IS : 1885 (Part 11)-1966 Electrotechnical vocabulary : Part 11 Electrical measurements
IEC Pub 68-2 : Basic environmental testing procedures, Part 2 Tests :	IS : 9000 Basic environmental testing procedures for electronic and electrical items :
IEC Pub 68-2-1(1974) Tests A : Cold (Test Ab)	IS : 9000 (Part 2/Sec 3)-1977 Cold test, Section 3 Cold test for non-heat dissipating items with gradual change of temperature
IEC Pub 68-2-2(1974) Test B : Dry heat (Test Bb)	IS : 9000 (Part 3/Sec 3)-1977 Dry heat test, Section 3 Dry heat test for non-heat dissipating items with gradual change of temperature
IEC Pub 68-2-3(1969) Test Ca : Damp heat, steady state	IS : 9000 (Part 4)-1979 Damp heat (steady state)
IEC Pub 68-2-4(1960) Test D : Accelerated damp heat [Superseded by IEC Pub 68-2-30(1980)]	IS : 9000 (Part 5)-1981 Damp heat (cyclic)
IEC Pub 68-2-6(1982) Test Fc and guidance : Vibration (sinusoidal)	IS : 9000 (Part 8)-1981 Vibration (sinusoidal) test IS : 9001 (Part 13)-1981 Guidance for environmental testing : Part 13 Vibration (sinusoidal) test
IEC Pub 68-2-8(1960) Test H : Storage [Superseded by IEC Pub 68-2-48(1982)]	IS : 9001 (Part 14)-1981 Storage tests
IEC Pub 68-2-11(1981) Test Ka : Salt mist	IS : 9000 (Part 11)-1983 Salt mist test
IEC Pub 68-2-13(1983) Test M : Low air pressure	IS : 9000 (Part 13)-1981 Low air pressure tests
IEC Pub 68-2-14(1974) Test N : Change of temperature	IS : 9000 (Part 14)-1978 Change of temperature
IEC Pub 68-2-17(1978) Test Q : Sealing (Test Qg*, Qf)	IS : 9000 (Part 15)-1982 Sealing test

*Since withdrawn.

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<i>International Standard</i>	<i>Corresponding Indian Standard</i>
IEC Pub 68-2-29(1968) Test Eb : Bump	IS : 9000 (Part 17/Sec 2)-1979 Impact test, Section 2 Bump
IEC Pub 68-2-32(1974) Test Ed : Free fall (procedure 1)	IS : 9000 (Part 7/Sec 4)-1979 Impact test, Section 4 Free fall
IEC Pub 86(1982) Primary batteries	IS : 203-1972 Dry batteries for flashlights (<i>third revision</i>)
IEC Pub 201(1966) Power sources for portable prospecting equipment for radioactive materials (<i>see</i> Note)	—
IEC Pub 278(1968) Documentation to be supplied with electronic measuring equipment	IS : 6756-1972 Technical documentation to be supplied with electronic measuring equipment
IEC Pub 348(1978) Safety requirements for electronic measuring apparatus	IS : 9858-1981 Safety requirements for measuring apparatus
IEC Pub 359(1971) Expression of the functional performance of electronic measuring equipment	IS : 9176-1979 Method for specifying the functional performance of electronic measuring equipment

Note — The technical committee responsible for the preparation of this standard has reviewed the provisions of this IEC standard and has decided that it is acceptable for use in conjunction with this standard.

In Table 1, under 'standard test conditions', a temperature of $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$ is specified against ambient temperature. The technical committee responsible for the preparation of this Indian Standard has adopted a value of 10°C to 40°C which is internationally accepted in IEC Pub 68-1 (1982).

Only the English language text of the International Standard has been retained while adopting it in this Indian Standard.

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CHAPTER I: GENERAL

1. Scope

This recommendation applies to linear scale instruments used in general, regional and local prospecting and for subsurface and deep survey, excluding radiometric bore hole logging probes.

These instruments usually comprise the following:

- a detecting device with one or more Geiger-Müller counter tubes;
- a counting rate meter;
- a power supply;
- a listening device.

A radioactive source for checking is usual.

2. Object

The object of this recommendation is:

- to state requirements for instruments;
- to list the information to be provided in the instruction manual by the manufacturer (see IEC Publication 278, Documentation to be Supplied with Electronic Measuring Apparatus).

3. Terminology

The following definitions conform to the I.E.V.¹⁾, and to IEC Publication 359, Expression of the Functional Performance of Electronic Measuring Equipment.

3.1 *Rating of an instrument* (in terms of the quantity measured)

The value of the quantity which corresponds to the upper limit of the effective range (I.E.V. 20-40-050).

3.2 *Effective range*

That part of the scale where measurements can be made with the stated accuracy (I.E.V. 20-40-035).

3.3 *Influence quantity*

One of the quantities which affect the indication of an instrument, but which is not the one measured by the instrument (I.E.V. 20-40-060).

¹⁾ Subject to modifications being considered which may be introduced into I.E.V., Chapter XX, third edition.

3.4 *Reference conditions*¹⁾

A set of values with tolerances, or of restricted ranges of influence quantities and if necessary of influencing characteristics, specified for making comparison and calibration tests.

3.5 *Intrinsic error*¹⁾

The error determined under reference conditions.

3.6 *Rated range of use*¹⁾

The range of values for an influence quantity within which the requirements concerning operating error are satisfied.

3.7 *Rated operating conditions*¹⁾

The whole of the effective ranges for performance characteristics and rated ranges of use for influence quantities, within which the performance of the apparatus is specified.

3.8 *Limit conditions of operation*¹⁾

The whole of the ranges of values for influence quantities and performance characteristics (beyond the rated ranges of use and effective ranges respectively) within which an apparatus can function without resulting in damage or degradation of performance when it is afterwards operated under rated operating conditions.

Note. — The limit conditions will, in general, include overload.

3.9 *Storage and transport conditions*¹⁾

The whole of the conditions of temperature, humidity, air pressure, vibration, shock, etc., within which the apparatus may be stored or transported in an inoperative condition, without resulting in damage or degradation of performance when it is afterwards operated under rated operating conditions.

3.10 *Accuracy class*¹⁾

A group of apparatus which have, for one particular basic parameter, an accuracy designated by a common number, this being the limit of error expressed as a percentage or otherwise (dB), when the apparatus is used under reference conditions. This common number is termed the *class index*.

Note. — An apparatus having more than one basic parameter may have a different class index for each of them.

3.11 *Absolute sensitivity*

The ratio of the change in the deflection to the corresponding change in the quantity to be measured (I.E.V. 20-40-040).

3.12 *Coefficient of variation (of a set of measurements)*²⁾

The ratio between the standard deviation and the absolute value of the arithmetic mean of a set of n measurements x_i given by the following formula:

¹⁾ Definitions taken from IEC Publication 359.

²⁾ From Draft ISO Recommendation No. 1786.

$$V = \frac{\sigma}{\bar{x}} = \frac{\sqrt{\frac{\sum_1^n (x_i - \bar{x})^2}{n-1}}}{\bar{x}}$$

where: x_i is the i th indication given by the instrument ($i = 1, 2, 3, \dots, n$) and \bar{x} is the absolute value of arithmetic mean of the n indications taken into consideration.

3.13 *Response time of a measuring instrument*

The time required after a step variation in the measured quantity until the output signal variation reaches a given percentage of its final value.

3.14 *Counting loss (of a pulse counting assembly)*

A reduction of the counting rate due to causes such as the pile up or the resolving time.

3.14.1 *Fractional counting loss (of a pulse counting assembly)*

Counting loss referred to the number of received data.

3.15 *Threshold of detectability*

The least value of change of counting rate which can be distinguished at a given confidence level from the statistical fluctuations in the measured value.

4. **Categories of instruments**

Two categories of instruments are defined:

- *Category A*: instruments intended for exploration in temperate and tropical regions.
- *Category B*: instruments intended for exploration in cold regions.

CHAPTER II: REQUIREMENTS

5. Test conditions

Except where otherwise specified, the standard test conditions to be applied are given in Table I.

With the exception of the check of intrinsic error and of performance characteristics, the tests enumerated in this draft are to be considered as "sampling tests", that is, it is not intended that they shall be carried out on all instruments of a given type, but only on some representative instruments of the type.

On the contrary, the checks of intrinsic error and of performance characteristics (Clause 6) shall be carried out on each instrument.

TABLE I
Reference conditions and standard test conditions

Influence quantity	Reference conditions *	Standard test conditions
Warm-up time	1 minute	
Ambient temperature	20 °C	20 °C \pm 1 °C
Relative humidity	65%	45% to 75%
Atmospheric pressure	1 013 mbar (101.3 k Pa)	700 mbar to 1 060 mbar (70 k Pa to 106 k Pa)
Power supply voltage	Nominal power supply voltage	Nominal power supply voltage \pm 5%
Position	Normal position as stated by the manufacturer	Normal position \pm 5°
Magnetic induction of external origin	Earth's magnetic field	Less than twice the induction due to the earth's magnetic field

* See Sub-clauses 3.3 and 3.4.

6. Accuracy

6.1 Intrinsic error

Under standard conditions (Table I) with the radiation meter adjusted according to the manufacturer's instructions, the assembly shall measure the fluence rate, for the specified incident radiation (under consideration) and in the prescribed calibration direction. At any point on the meter scale, the intrinsic error shall not exceed the following values, according to accuracy class:

Class 5 = 5%.

Class 10 = 10%.

Class 20 = 20%.

These values shall be referred to the instrument ratings ¹⁾.

6.2 Rated operating error

The rated operating conditions shall be defined as follows:

Temperature ²⁾ = Category A: -10 °C to +40 °C
Category B: -25 °C to +30 °C.

Atmospheric pressure = 700 mbar to 1 060 mbar.

Relative humidity = 10% to 95%.

Power supply voltage = range corresponding to the battery life time, as specified by the manufacturer.

The maximum rated operating error shall not exceed the following values, according to accuracy class:

Class 5 = 7%.

Class 10 = 15%.

Class 20 = 30%.

These values shall be referred to the instrument ratings ¹⁾.

6.3 Error for limit conditions of operation

The limit conditions of operation shall be defined as follows:

Temperature ²⁾ = Category A: -25 °C to +55 °C
Category B: -40 °C to +40 °C.

Atmospheric pressure = 700 mbar to 1 060 mbar.

Relative humidity = 10% to 95%.

Power supply voltage = range corresponding to the battery life time, as specified by the manufacturer.

The maximum error for limit conditions of operation shall not exceed the following values, according to accuracy class;

Class 5 = 9%.

Class 10 = 20%.

Class 20 = 40%.

These values shall be referred to the instrument ratings ¹⁾.

7. Intrinsic requirements

7.1 Scale graduation

7.1.1 To make comparisons easier, it is desirable that all the instruments be graduated in the same unit or at least that the given indications may be converted into this same unit. The recommended unit is the fluence rate for a degenerated spectrum corresponding to the spectrum usually met in prospecting work, where the medium is regarded as semi-infinite (2π).

If the instrument is graduated in this unit, the manufacturer shall furnish, for each range, the relationship between the graduation and the mean number of events detected per unit time, at least at one-third of each range.

¹⁾ See definition 3.1.

²⁾ See Sub-clause 9.1.1.

- 7.1.2 If the instrument is graduated in mean number of events detected per unit time, the manufacturer shall specify the conditions under which the calibration was obtained. Further, the manufacturer shall furnish such spectral, directional and other response data necessary for converting the read-out to fluence rate, at least at one-third of each range. The unit time shall be the second.

7.2 Ratings ¹⁾

The instrument usually has several ratings.

- The ratio of the highest rating to the lowest shall not be less than 10²; it shall be possible to carry out measurements from the lowest values (corresponding to an area of water not less than 3 metres deep), to the highest values likely to be encountered in prospecting.
- The ratio between successive ratings shall not be greater than 10 and should be preferably between 2 and 5.

7.3 Counting ratemeter characteristics

7.3.1 Coefficient of variation

The coefficient of variation determined at one-third of each range of the instrument shall be within one of the following series:

0.5% — 0.10% — 0.20%.

The manufacturer shall specify the method used for determining this characteristic.

7.3.2 Response time

Response time shall be determined at 86.5% of the end value; this corresponds to twice the time constant of the instrument.

The manufacturer shall indicate if he has determined this characteristic by calculation, or by test; if by test, the method used shall be described.

TABLE II

Example of relationship between the characteristics of the ratemeter for an instrument with 3 ranges

Rating ¹⁾ expressed in c.p.s.	Coefficient of variation (%)	Time constant (s).	Response time (s)
1 110	4.8	0.6	1.2
111	6.7	3	6
11	19.4	3.6	7.2
* 11	11.8	9.6	19.2

* "Test" position.

7.4 Fractional counting loss

The fractional counting loss determined for the maximum value of each effective range of the instrument shall be included in one of the following series:

0.5% — 0.10% — 0.20%

¹⁾ See definition 3.1.

7.5 *Threshold of detectability*¹⁾

The threshold of detectability shall be determined at one-third of the lowest rating²⁾ of the instrument at the confidence level of 99%; this correspond to three times the standard deviation of the measurement at this point.

In the example given in Table II, the threshold of detectability for the lowest rating is 2.2 and 1.6 for the coefficients of variation of, respectively, 19.4% and 11.8%.

7.6 *Zero drift*

After the assembly has been switched on for a period of 30 minutes, in normal operating conditions and after making an initial zero setting, the position of the zero point of the meter indication shall not vary by more than 1% of the full-scale deflection on any range in 8 hours.

7.7 *Warm-up time*

The warm-up time determined at one-third of the lowest rating²⁾ shall not exceed ten times the greatest response time. The deviation shall remain within the intrinsic error limits of Sub-clause 6.1.

8. **Power supply requirements**

8.1 *Type of power supply*

The instruments shall permit the use of primary cells of the "R20" type, as defined in IEC Publication 86, Primary Cells and Batteries, as the source of power except where dimensional specifications preclude the use of these cells. Several primary cells may be connected in any desired manner but each shall be individually replaceable (see IEC Publication 201, Power Sources for Portable Prospecting Equipment for Radio-active Materials).

8.2 *Battery life*

In continuous service, the battery life should be at least equal to 24 hours, and shall, in any case, be not lower than 10 hours.

Battery check facilities shall be provided.

8.3 *Effect of supply voltage variation*

The drift due to the variation in power supply voltage corresponding to the battery life specified by the manufacturer shall be included within the limits of rated operating error of Sub-clause 6.2 and of error for limit conditions of operation of Sub-clause 6.3 respectively.

9. **Requirements for resistance to environmental conditions**

The instrument shall withstand the following environmental conditions:

9.1 *Climatic conditions (instrument in the operating state)*

¹⁾ See definition 3.15.

²⁾ See definition 3.1.

9.1.1 *Dry heat and cold*

The normal operating temperature range shall be:

Category A
-10 °C to +40 °C

Category B
-25 °C to +30 °C

The limiting operating temperature range shall be:

Category A
-25 °C to +55 °C

Category B
-40 °C to +40 °C

Tests shall be carried out in conformity with Test Ab of IEC Publication 68-2-1: Test A: Cold and Test Bb of Publication 68-2-2: Test B: Dry Heat.

9.1.2 *Damp heat*

The normal operating temperature range shall be:

Category A
+25 °C to +40 °C

Category B
+25 °C to +40 °C

Tests shall be carried out in conformity with IEC Publication 68-2-4: Test D: Accelerated Damp Heat, with severity V corresponding to 2 test cycles with the instrument in operating state and a check after the recovery period.

9.2 *Storage and transport conditions (instrument switched off)*

The instrument shall withstand the following storage and transport conditions: (see definition 3.9).

9.2.1 *Dry heat and cold*

A period of at least two months at a temperature range as listed below:

Category A
-40 °C to +55 °C

Category B
-55 °C to +55 °C

Tests shall be carried out in conformity with IEC Publication 68-2-8: Test H: Storage, Test Ab of IEC Publication 68-2-1 and Test Bb of IEC Publication 68-2-2.

9.2.2 *Damp heat*

A period of at least two months with the instrument unpacked, at a temperature range as listed below:

Category A
+40 °C

Category B
+40 °C

Tests shall be carried out in conformity with IEC Publication 68-2-3: Test Ca: Damp Heat, Steady State, with the following severity, with the instrument switched off, unpacked, and power supply removed.

56 days, the temperature and relative humidity maintained at $+40 \pm 2$ °C and $93 \pm \frac{2}{3}\%$.

The recommended procedure consists of the following: 2 tests in the operating state, one test in the storage conditions, recovery under standard atmospheric conditions over a period of 1 to 2 hours, and one test in the operating state.

9.2.3 *Rapid changes of temperature*

Rapid changes of temperature as follows: -10 °C to +30 °C for A and B categories.

Tests shall be carried out in conformity with IEC Publication 68-2-14: Test N: Change of Temperature. Each temperature shall be maintained for 3 hours, the time taken for the change-over shall be not less than 2 minutes and not more than 3 minutes.

9.2.4 Low-air pressure

Transport of the packaged instrument, Categories A and B, for a period of at least 12 hours with a pressure of 300 mbar (corresponding to an altitude of 8 500 metres).

Tests shall be carried out in conformity with IEC Publication 68-2-13: Test M: Low-air Pressure.

9.3 Water proofing

9.3.1 Rain and splash

The instrument, in its usual operating position and in the operating state, shall be subject to the driving rain test, the spray being directed downwards at an angle of 45° for a period of 1 hour.

The variation of the indication given by the instrument when put in operation again shall not exceed that from the intrinsic error.

Tests shall be carried out in conformity with Test Qg: Driving Rain, of IEC Publication 68-2-17: Test Q: Sealing.

9.3.2 Immersion

If the instrument is stated to be "waterproof", it shall be capable of immersion without damage under 1 metre of water for a period of 30 minutes.

If the instrument is claimed to be "buoyant", it shall withstand a fall into water from a height of 2 metres and then float.

Tests shall be carried out in conformity with Test Qf: Immersion, of IEC Publication 68-2-17.

9.4 Salt mist

If specified.

Tests shall be carried out in conformity with IEC Publication 68-2-11: Test Ka: Salt Mist.

9.5 Explosive atmosphere

If the instrument is to be used in an explosive atmosphere, it shall conform with IEC recommendations and with the safety regulations of the country of operation and shall have received the necessary acceptance certificates.

9.6 Vibration

The instrument packed for transport shall withstand without damage vibration of amplitude 1 mm from peak-to-peak in the frequency range from 10 Hz to 55 Hz.

Tests shall be carried out in conformity with IEC Publication 68-2-6: Test Fc: Vibration (sinusoidal).

The instrument packed for transport shall undergo a 1 hour proof of endurance for vibration in each of 3 directions, of amplitude 1 mm from peak-to-peak, with continuous sweeping from 10 Hz to 55 Hz in 1 minute. The variation of the indication given by the instrument in operation before and after the test shall not exceed 5% of the rating ¹⁾.

¹⁾ See definition 3.1.

9.7 *Bumps*

The instrument, switched off, shall withstand without damage bumps corresponding to pulses of peak acceleration 10 g with a repetition rate of a bump every 2 seconds.

Tests shall be carried out in conformity with IEC Publication 68-2-29: Test Eb: Lump.

The instrument, switched off, shall be subject to 100 bumps successively in three orthogonal directions corresponding to pulses of peak acceleration 10 g with a repetition rate of a bump every 2 seconds.

The variation of the indication given by the instrument in operation before and after the test shall not exceed 5% of the rating ¹⁾.

9.8 *Falls*

9.8.1 The instrument, in the operating, state shall withstand without damage one fall on to concrete from a height of 0.50 metre.

The variation of the indication given by the instrument shall not exceed 5% of the rating ¹⁾.

9.8.2 The instrument switched off and packed shall withstand without damage one fall onto concrete from a height of 1 metre.

The variation of the indication given by the instrument put again in operation shall not exceed 5% of the rating ¹⁾.

Tests shall be carried out in conformity with IEC Publication 68-2-32: Test Ed: Free Fall.

10. **Safety requirements**

The instruments shall be in compliance with the safety requirements of IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus.

Furthermore, the external connections of instruments which operate at a voltage greater than safety extra-low voltage shall be in conformity with the following safety requirements against electric shock:

10.1 *Accessible metal connecting parts*

The instruments shall belong to the safety class II ²⁾.

All accessible external conductive parts of safety class II instruments (air and land vehicle-mounted instruments and portable self-powered instruments) must be at the same potential. They shall be set up so that no dangerous difference of voltage appears between the instrument and neighbouring conductive parts.

10.2 *Protective device for accessible parts of live connectors (excluding safety extra-low voltage)*

10.2.1 *Impedance as seen from exterior*

The circuit impedance, as seen from the exterior of accessible live conductors, must be as high as possible, consistent with the proper functioning of the instrument.

¹⁾ See definition 3.1.

²⁾ As defined in IEC Publication 348.

10.2.2 The maker shall specify the maximum direct current which would flow through a 2000 ohms resistance connected between accessible parts of live connectors and between these accessible parts and external metal.

10.2.3 *Mechanical protective device*

The connector carrying such circuits as supply, bias, etc., and when not mated presenting accessible live parts, must be protected by a cover.

10.3 *Marking*


The instruments shall be marked as follows according to the maximum direct current as defined in Sub-clause 10.2.2.

- | | |
|---------|---|
| 2 mA | Direct currents below 2 mA. (currents recognized as unable to cause a significant electric shock). |
| 2-25 mA | Direct currents between 2 mA and 25 mA. (currents, not necessarily safe that, if flowing through the human body, correspond to the so-called "safety" maximum voltage). |



Direct currents higher than 25 mA (currents recognized as unsafe).

The marking will be made on the instrument near the connector(s).

The marking  will be made in red.

CHAPTER III: SPECIFICATIONS TO BE GIVEN IN THE INSTRUCTION MANUAL

IEC Publication 278, Documentation to be Supplied with Electronic Measuring Apparatus, requires the instruction manual as a mandatory document. This instruction manual shall contain "the information necessary for the correct application, operation, maintenance and repair of the apparatus and for understanding its operation".

In addition to the main characteristics to be given in conformity with IEC Publication 278, the manufacturer shall indicate the characteristics as listed below in Clauses 11 to 15.

11. General characteristics

- 11.1 The purpose of all inputs and outputs together with their mechanical and electrical characteristics.
- 11.2 The dimensions in mm and the mass in kg of the instrument and accessories when ready for use; those of the accessories may be given separately, if appropriate, also those of the carrying case, if separate.
- 11.3 The dimensions and mass likewise of the instrument and accessories when packed for transportation.
- 11.4 The type, number and dimensions of all Geiger-Müller counter tubes used in the instrument.

12. Power supply characteristics

- The type, number and nominal voltage of batteries.
- The battery life in continuous service.
- The battery life in intermittent service for an operating time of 4 hours per day.

13. Performance characteristics

13.1 Under reference conditions:

- Intrinsic error and accuracy class.
- The sensitivity expressed in mm of deflection on the meter scale per photon $\text{m}^{-2} \cdot \text{s}^{-1}$ on the most sensitive range.
- All data necessary for converting the graduation into the average number of detected events per unit time, or graduation into fluence rate, as specified in Sub-clause 7.1.
- The coefficient of variation at the one-third value in each of the ranges of the instrument.
- The response time determined at 86.5% of the end value.
- The fractional counting loss at the maximum value of each range of the instrument.
- The threshold of detectability at the one-third value in the lowest range for a confidence level of 99%.
- The zero drift in each range over 8 hours.
- The warm-up time at the one-third value in the lowest range of the instrument.

- 13.2 Under rated operating conditions: the accuracy.
- 13.3 Under limit conditions of operation: the accuracy.
- 14. **Storage and transport conditions**
 - The climatic conditions of storage and transport.
 - The maximum deviation of the instrument resulting of vibrations, bumps and falls.
- 15. **Safety characteristics**
 - The maximum direct current as defined in Sub-clause 10.2.2.